

COMBUSTION APPLIANCE SAFETY INSPECTION FORM INSTRUCTIONAL SUPPLEMENT (IS)

TABLE OF CONTENTS

“X”—CAS PROCEDURES	1
X-1 COMBUSTION APPLIANCES “AFFECTING THE LIVING SPACE”	1
X-2 COMBUSTION APPLIANCES “NOT AFFECTING THE LIVING SPACE”	1
X-3 APPLIANCES SHARING A “COMMON VENT”	1
X-4 TEST CONDITIONS AND PROCEDURES	1
X-5 OUTDOOR TEMPERATURE	2
X-6 WHEN TO PERFORM CAS TESTS (See Field Policy Preface for WIS Section 3)	2
X-7 OPEN-DOOR & CLOSED-DOOR TESTS	3
X-8 DRAFT TEST HOLES	3
X-9 CO TEST LOCATIONS (See WIS Items 27–31)	4
“Y”—CVA, DRAFT and CO REQUIREMENTS.....	5
Y-1 COMBUSTION & VENTILATION AIR (CVA) (See WIS Section 3, Item 8 and Appendix A).....	5
Y-2 DRAFT TESTS	8
Y-3 CO TESTS.....	9
“Z”—ACTION INSTRUCTIONS	10
Z-1 CONDITIONS REQUIRING IMMEDIATE SERVICE (HAZARDOUS CONDITIONS).....	10
Z-2 REQUIRED REPAIRS	11
Z-3 GAS LEAKS AND SOLDERED/UNSAFE GAS CONNECTORS.....	12
Z-4 FLUE AND VENT DEFECTS.....	14
Z-5 BURNER ABNORMALITIES	15
Z-6 DEFAULT BTU/HOUR INPUT RATINGS.....	16
Z-7 ABANDONED APPLIANCES	16
Z-8 RECOMMENDED REPAIRS	16
Z-9 CO TESTER PROBE EXTENSIONS	17
Z-10 SOLDERED & OTHER UNSAFE FLEXIBLE GAS CONNECTORS.....	18
Z-11 AUTOMATIC GAS SHUTOFF VALVE	19
Z-12 “NOx ROD” FURNACE RECALL INFORMATION.....	20

WIS Items referenced in this document are in WIS Section 3

“X”—CAS PROCEDURES

X-1 COMBUSTION APPLIANCES “AFFECTING THE LIVING SPACE”

1. Appliances affecting the living space are identified in **WIS Item 2**.
2. Complete CAS Testing must be performed on all of those appliances—even if one fails, or if one cannot be completely tested.
3. See **Z-7** regarding abandoned appliances, and see **Z-5.2** regarding malfunctioning Cook Top/Oven.

X-2 COMBUSTION APPLIANCES “NOT AFFECTING THE LIVING SPACE”

1. Appliances affecting the living space are also identified in **WIS Item 2**.
 - They are usually appliances located more than 4' from a window/door leading into the living space—such as in outdoor enclosures and detached structures.
2. Minimum examination of those appliances is a check for Gas Leaks (see **Z-3** and **WIS Item 7**).
3. Gas Leaks must be repaired (see **Z-3**).
4. Repair is not required for other defects, if combustion products will not enter the living space. However, nonconforming conditions must be brought to the attention of the owner or rental agent and documented as “**Recommended Repairs**” (see **Z-8**), with a notation in CASIF Section (D).

X-3 APPLIANCES SHARING A “COMMON VENT”

When two appliances share a Common Vent, operate *both* appliances simultaneously during tests, as described in **WIS Item 22**.

- Exception: When CO in one appliance is sampled beyond the common vent wye, turn off the other appliance during that CO Test. You will need to do that when:
 - CO is checked at the vent termination of an Induced Draft Furnace, or
 - CO is measured in a test hole drilled in the common vent pipe beyond the wye.

X-4 TEST CONDITIONS AND PROCEDURES

1. Ambient CO Tests

- a. See **WIS Items 20 and 21**, and **WIS Appendix B**, for test conditions and test procedures.
- b. Record test results in CASIF Section (F).

2. Flue Gas CO and Draft Tests

- a. See **WIS Item 22** for test conditions.
- b. Perform Draft Tests per **WIS Item 23** (**Items 30 and 31** for Gas Logs & Gas Fireplaces/Inserts).
- c. Perform Flue Gas CO Tests per **WIS Items 24 – 31**.
- d. Record test results in the CASIF Section that applies to the appliance being tested.

3. Fans and Exhaust Devices

- a. These include the following:
 - Fans and exhaust devices which exhaust air from the building (vented directly outdoors or into an attic or crawlspace), and
 - The FAU air handler.
- b. Operation
 - They are operated during testing of Open Combustion Space Heaters (including Gas Log) and Water Heaters, because depressurization from fans may affect those appliances.

- For fan-on requirements, see **WIS Item 22** ► “The following must be operating during tests of Open Combustion Space Heaters, Water Heaters, and Fireplace Gas Logs and Inserts”.

4. Following is some helpful information about Fans and Exhaust Devices:

- Range Hood is operated if ducted outdoors, but *not* when Range Hood fan *recirculates* indoor air.
- Clothes Dryer is operated if exhausted outdoors (see **WIS Item 29**):
 - The lint filter must be clean, and the drum should be empty.
 - The drum may be left “as found” (i.e., may contain clothing) during the CO test, but if CO exceeds the action level, the drum must be emptied and CO re-checked.
- Central Vacuum System: If a hose must be “plugged in” to activate the system, use the inlet closest to the combustion appliance zone that would be most affected, such as an area with an:
 - Open Combustion appliance located in the living space (e.g., a Water Heater in the kitchen), or
 - Enclosure taking CVA from living space (e.g., hall closet with FAU and/or Water Heater).
- Whole House Fan *may* be operated during CAS testing, but *only when* an Open Combustion Water Heater or FAU being tested is *located in the attic*, and only as prescribed in **WIS Item 22** ► “Whole House Fan Exhausting into the Attic and Natural Draft Appliance Present in Attic”.
- FAU Air Handler Fan: Operate the Air Handler on high speed, when possible.
 - When there is a Fan control with “Auto” and “On” positions, the “On” position usually operates the fan at high speed.
 - If there is a fan speed control on the furnace itself, select the highest speed used for cooling.
 - When *not* checking Draft & CO on the FAU itself, it is better to run the *fan only* (burner off) to avoid over-heating the home. When the wall thermostat has a separate Fan control, switch the “Heat-Off-Cool” control to Off and the “Fan” control to On.

5. **Other Appliances**

- Operate all other Open Combustion vented appliances which can affect operation of appliances being tested (e.g., Water Heater in the same enclosure/space with a Furnace).
- Exception: Operate appliances sharing a “Common Vent”, as prescribed above in **X-3**.

6. **Filters**

- Kitchen Exhaust Fans and Clothes Dryer: Clean or remove dirty filters (e.g., Range Hood filters).
- FAU: Make sure air filter is clean or removed during CAS tests.
 - After tests, dirty filters must be cleaned or replaced.
 - Do not leave an FAU with a dirty, clogged filter.

X-5 OUTDOOR TEMPERATURE

- Measure temperature in the shade. Required only if Instrumented Draft Tests will be performed.
- When Draft Tests are performed at different times of day, recheck outdoor temperature each time.

X-6 WHEN TO PERFORM CAS TESTS

- Perform CAS tests in accordance with the **Field Policy Preface for WIS Section 3**.
 - CAS “Pre-Wx Tests”** *prior* to installing any Wx measures.
 - CAS “Interim Tests”** when Shell or Duct Sealing is not completed by the end of the day.
 - CAS “Post-Wx Tests”** after weatherization is complete, but only when required by policy.
 - CAS “Post-Repair/Replacement Tests”** the same day Repair/Replacement is finished.
- Use the applicable CAS form (for Additional Space/Water Heater, Interim CAS Tests, and Post-Repair/Replacement Safety Checks), as prescribed in **WIS Appendix M**, “CASIF & IS”.
- If a **CAS Interim Test** or **Post-Wx Test** reveals a condition with *Immediate Service Required*, and corrections are *not* made before the crew leaves the premises, follow instructions in IS Section **Z-1** and the Field Policy Preface for WIS Section 3.

X-7 OPEN-DOOR & CLOSED-DOOR TESTS

1. General:

- a. When possible, CO and Draft Tests must be performed with doors to the room or space containing the tested appliance both open and closed, with the results of each test recorded separately.
- b. When the enclosure is too small for a person to fit inside with the door closed, it is OK to do only the "Open Door" Test and circle "N/A" in the "Closed Door" box.

2. Confined Area/Hallway: For an appliance in a confined area that can be closed off completely with doors (e.g., Wall Furnace or appliance enclosure located in a closeable hallway):

- a. Do "Closed Door" Test with all hallway doors closed.
- b. Do "Open Door" Test with hallway door(s) open to a common area (e.g., Kitchen, Living Room).

3. Garage: See **WIS Item 22** ► "Door/Window Positions for CAS Tests in an Unconditioned garage".

4. Attic and Crawl Space: See **WIS Item 22** ► "Attic and Crawlspace—Access Door/Cover" and "Attic and Crawlspace—Fans Affecting the Space"

X-8 DRAFT TEST HOLES

1. For detailed criteria, see **WIS Section 3**:

- a. For Space Heaters and *Storage* Water Heaters, see **Item 23**
- b. For *Tankless* Water Heaters, see **Item 27**.

2. Appliances requiring Draft Test:

- a. All *Natural* Draft Space Heaters and Storage Water Heaters, *when* drilling a test hole is feasible.
- b. *Induced* Draft Space Heaters and Storage Water Heaters: *only when* a hole is drilled for Flue Gas CO Test. (If a CO Test hole is unneeded, it is *not* necessary to drill a hole just for a Draft Test.)
- c. For *Tankless* Water Heaters, see detailed criteria in **WIS Item 27**.

3. Test Hole Locations:

- a. *Natural* Draft appliances: 12" to 24" above the Draft Hood, per **WIS Item 23**.
- b. *Induced* Draft appliances: Approximately 36" above the Inducer Fan, per **WIS Item 23**.
- c. *Tankless* Water Heaters: Per **WIS Item 27**.

4. Sealing Hole for Draft Test (See **WIS Item 23**)

- a. Single-Wall Pipe
 - After preliminary Draft Tests:
 - Seal the hole with a tight-fitting "Plug Button", or
 - *Temporarily* cover the hole with metallic tape.
 - After the last test is performed (e.g., Post-Wx Test), a Plug Button must be installed. It may be *additionally* secured with Metallic Tape or High-Temp Caulk (e.g., 450°F RTV red silicone).
- b. Double-Wall Pipe—When drilling is not prohibited by pipe manufacturer or local code:
 - Drill through the outer pipe wall and into the inner pipe wall.
 - Inner hole size: just large enough for the test probe to fit thru (e.g., 5/16" for 1/4" OD probe).
 - Outer hole size:
 - Enlarge it enough to insert the nozzle of a small tube of RTV silicone, and
 - Size it to be sealed with an available-size plug button (e.g. 7/16").
 - *Preferred Sealing Method (Recommended by Pipe Manufacturers):*
 - Insert the nozzle of a small tube of RTV silicone through the larger outer hole.
 - Apply enough caulk to seal the inner hole with a glob of the silicone.
 - Seal the outer hole with a properly-sized plug button.

- *Alternative Sealing Method:*
 - Seal both holes with a tight-fitting *stainless steel Tap Bolt* and RTV silicone.
 - Put caulk on the threads to seal the inner hole.
 - Size bolt to cover the larger outer hole and extend maximum 3/8" into the inner pipe.

X-9 CO TEST LOCATIONS (See WIS Items 27–31)

1. Natural Draft Open Combustion Appliances:

a. Furnace or Space Heater:

- Insert Probe or Extension into the exhaust port(s) inside the Draft Hood. Check *each* Exhaust Port on multi-burner units, and *record each reading separately*.
- When there is a baffle present (e.g., in a Wall Furnace), check CO on both sides of the baffle, and *record the higher number*.

b. Water Heaters:

- Storage: Insert the Probe Extension down into the Center Tube. Check on both sides of the baffle, and *record the higher number*.
- Tankless: See detailed criteria in **WIS Item 27**.

c. Clothes Dryer:

- Insert the Probe or Extension inside the Moisture Exhaust termination, or
- If lint screen is accessed from the top of the dryer, the Probe/Extension may be inserted deep into the lint screen cavity (to near the bottom of it, being careful not to hit the fan blade).

d. Gas Log:

- Place Probe or Extension just inside the top edge of the fireplace opening (not over the flame).
- Hold probe horizontally, and keep the end near the outside edge of the lintel.

e. Gas Fireplace (Free-Standing or Fireplace Insert):

Place Probe Extension into dilution air intake and point end down into the flue (as you would into a Water Heater center tube).

2. Cooking Appliances:

a. Cook Top:

- Hold Probe approx. 12" above flame, with grate in place. (Clean grate if very dirty/greasy.)
- Hold probe horizontally—do not point end of probe into the flame.

b. Griddle:

Insert Probe or Extension slightly into the port opening, with Griddle in place.

c. Oven or Broiler:

- Insert Probe into Oven exhaust termination (on a Range, usually at the back of the Cooktop).
- Ovens *vented outdoors*: (a) Test ahead of where dilution air is added, or (b) block dilution air inlet and insert Probe or Extension inside the vent termination outdoors.

3. Induced Draft Open Combustion:

a. Insert Probe or Extension inside the vent termination on the roof (or the sidewall, if horizontal).

- When roof climb is not feasible, or sidewall termination is hard to reach, use a 1/4" OD aluminum Probe Extension (up to 10' long).
- Insert the Probe Extension into the flue termination to measure CO free of outside air.

b. When vent termination is not accessible, but drilling a test hole is feasible, insert Probe into a CO Test hole drilled in the flue pipe (see **X-8.2.b.** and **WIS Item 23**).

4. Closed Combustion:

a. Inside the Flue termination on the roof or sidewall (e.g., on the roof for a Mobile Home FAU, or on the sidewall for a DV Wall Furnace).

b. Use same criteria as in 3.a. above.

5. No Access for Flue-Gas CO Sample:

- a. Examples of “no-access” to the flue termination include the following:
 - Roof climb not feasible (e.g., inaccessible or roofing is deteriorated).
 - Sidewall termination is not safely accessible.
 - Roof-Mount Furnace is on a tile roof.
 - Mobile Home Closed Combustion flue not accessible due to awnings along both sides.
- b. When there is “no access” to the flue termination, and Flue Gas CO cannot be measured, check Appliance Ambient CO:
 - In the supply register nearest the appliance, when it is an FAU.
 - Above the Heat Exchanger, when the appliance is not ducted (including Water Heaters)
- c. For instructions on measuring Appliance Ambient CO, see **WIS Appendix B**, Section 4.0 (for Space Heaters) and 5.0 (for Water Heaters).

“Y”—CVA, DRAFT and CO REQUIREMENTS**Y-1 COMBUSTION & VENTILATION AIR (CVA) (See WIS Section 3, Item 8 and Appendix A)****Y-1.1 OVERVIEW**

1. CVA requirements apply to Open Combustion appliances, which draw combustion air from the room/enclosure/space in which they are located.
 - The appliances can be “Natural Draft” (with a Draft Hood) or “Induced Draft” (with an Inducer Fan instead of a Draft Hood).
 - Combustion air can be obtained from *outdoors* (thru vents or ducts) or from *indoors* (using room volume).
2. CVA requirements apply to the *Furnace/Heater* and *Water Heater*. Cooking Appliances and Clothes Dryers are excluded in the evaluation of appliances installed *before 2008*.
3. The CVA requirement is based on the total Btu/hour Input rating of the appliances in the room/space/enclosure.
 - The Input rating is stated on the manufacturer’s nameplate.
 - When the nameplate is missing or illegible, use the default Btu/hr values specified in **Z-6**.
4. Also refer to **WIS Appendix A**, “Combustion Air Requirements for Gas-Burning Appliances”, for a summary of code requirements, definitions, and an easy-reference table of vent and duct sizes and room volume requirements for several common Btu/hour Input ratings.

Y-1.2 VENT NFVA (NET FREE VENTING AREA)

1. Combustion air is supplied to the appliance through CVA vents that “communicate” with outdoors or other interior rooms/spaces.
 - a. The required size of a vent is expressed as “Net Free Venting Area” (NFVA) in square inches.
 - b. All vents and ducts to *outdoors* must be screened—*except* ducts terminating in the attic, which may not be screened. Quarter-inch wire mesh is required on new vents.
 - c. Mesh is not required for vents to *indoor* spaces, such as: (a) vents between two rooms in the living space, and (b) vents in the door/wall of an appliance enclosure located inside a garage and vented into the garage.
2. The blocking effect of screen/mesh and louvers must be taken into account (explained in Appendix A) when calculating NFVA.
 - a. When a vent has screen/mesh and/or louvers, the vent’s “net free” venting area is less than the “gross area” (total size in sq. in.) of the opening.
 - When screen/mesh and/or louvers are *added* to an opening, *less air* can get thru the opening.
 - Thus, the screen/mesh and/or louvers *reduce* the “net free” area of the opening.

- b. When the NFVA rating is stamped on the vent, that value may be used.
- c. When the NFVA rating is not stamped on the vent, NFVA can be *estimated* by multiplying the gross opening area by a "Reduction Factor" shown in the table below.

SUGGESTED SCREEN* AND LOUVER REDUCTION FACTORS FOR COMBUSTION AIR VENTS (SEE APPENDIX A)

1/4" Mesh (Hardware Cloth)	1/4" Mesh with Metal Louvers or Louvers Only	1/4" Mesh with Wood Louvers or Louvers Only	Insect Screen (Mesh under 1/4")	Insect Screen with Metal Louvers	Insect Screen with Wood Louvers
0.90 (90%)	0.75 (75%)	0.25 (25%)	0.50 (50%)	0.50 (50%)	0.25 (25%)

*Note: 1/4" Mesh has wires spaced 1/4" apart ("quarter-inch hardware cloth")—specified in the 2007 CMC (Article 701.9). Screen with a weave tighter than 1/4" (referred to in the table as "insect screen") can have wires 1/8" apart, or they can be 1/16" apart (as in insect screen used in windows and doors).

3. Example Vent Size Calculations:

- a. **When Gross Opening Area is known:** Determine its NFVA, by *multiplying* the Gross Opening area by the Reduction Factor. **(Gross Opening Area) x (Reduction Factor) = NFVA.**
 - Assume a vent has a 5" x 10" opening that is covered with **1/4" mesh only** (no louvers).
5" x 10" = 50 sq. in. Gross Opening. 50 sq. in. x **0.90** = 45 sq. in. NFVA.
 - With **1/4" mesh plus metal louvers**: 50 sq. in. x **0.75** = 37.5 sq. in. NFVA.
- b. **When the NFVA requirement is known:** Determine the Gross Opening Area required by *dividing* the NFVA by the "Reduction Factor". **(NFVA) ÷ (Reduction Factor) = Gross Opening Area** needed to provide the required NFVA. Using the above example in reverse...
 - To provide 45 sq. in. of NFVA, a vent with **1/4" mesh-only** must have a Gross Opening Area of 50 sq. in. (45 sq. in. NFVA ÷ **0.90** = 50 sq. in. Gross Opening Area).
 - To provide 37.5 sq. in. of NFVA, a vent with **1/4" mesh plus metal louvers** must have a Gross Opening Area of 50 sq. in. (37.5 sq. in. NFVA ÷ **0.75** = 50 sq. in. Gross Opening Area).

Y-1.3 CVA VENTS AND DUCTS TO OUTDOORS

For appliances in an enclosure, two vents (or ducts) to outdoors—one Upper and one Lower—are *usually* installed. However, using *only* an *Upper* vent (no Lower vent) is also allowed (see **WIS Item 8** or **Appendix A**).

1. Two CVA Vents/Ducts—Upper and Lower

- a. The Lower CVA vent/duct must be located within 12" of the floor (or in the floor) of the enclosure.
- b. The Upper CVA vent/duct must be located within 12" of the ceiling (or in the ceiling).
 - Exception: A pre-existing Upper vent/duct located at any height above the Draft Hood opening is acceptable for CVA *evaluation* purposes (but not for new CVA installations).
- c. When **vents or vertical ducts** are used, *each* must provide 1 sq. in. NFVA for each **4,000 Btu/hr** of total Input of the FAU and/or Water Heater drawing combustion air from that room/space.
 - The Lower vent may be a vertical duct extending down from the attic and terminating within 12" of the floor. The ends must not be screened.
 - The Upper vent may not be a duct extending up from the crawlspace. The main function of the Upper vent is to exhaust heat and gases outdoors, so it must **start at the top** of the enclosure and vent to the attic or outdoors.
- d. When **horizontal ducts** are used, *each* must provide 1 sq. in. NFVA per **2,000 Btu/hr** Input.

2. One CVA Vent/Duct—Upper Only

- a. For appliances in an enclosure, an Upper vent/duct *alone* (no Lower vent) is allowed, under the following conditions:
 - The appliance has clearances of at least 1" on the sides and back, and 6" in front.
 - NFVA of the Upper-only vent or duct equals 1 sq. in. per **3,000 Btu/hr** of total Input ratings—but *not less than* the total of the cross-sectional areas of all vent connectors in the enclosure.

- b. Example: if there is a 3" Water Heater vent connector (7.1 sq. in. area) and a 6" Furnace vent connector (28.3 sq. in.), the total of the cross-sectional areas is **35.4 sq. in.** (See table in Item 3 below for cross-sectional areas of round flue/vent pipes.)
- The Upper-only CVA vent must have *at least* **35.4 sq. in.** NFVA, regardless of Btu/hr total.
 - Assume appliance Input total in the enclosure is 90,000 Btu/hr. Based on 1 sq. in. per 3,000 Btu/hr Input: $90,000 \div 3,000 = 30 \text{ sq. in.}$ However, the CVA vent NFVA must be **35.4 sq. in.** to match the total cross-sectional area of the two vent connectors.

3. Mobile Home Water Heater Upper Combustion Air Vent

When the Upper vent is created by passing the appliance vent pipe through the center of a larger pipe, NFVA of the Upper vent equals the area of the space between the outer and inner pipes. That area may be calculated by doing the following:

- Measure the diameter (or circumference) of each pipe.
- Obtain the "Pipe Area (sq. in.)" for each pipe from the table below.
- Subtract smaller pipe area from larger pipe area to determine NFVA of the space between them.
- Example: If the inner pipe (Water Heater vent) diameter is **3"**, and the outer pipe in the CVA assembly diameter is **6"**, the space between them is 21.2 sq. in. NFVA ($28.3 - 7.1 = 21.2 \text{ sq. in.}$).

CONVERSION OF PIPE DIAMETER OR CIRCUMFERENCE TO PIPE CROSS-SECTIONAL AREA								
Pipe Diameter (in.)	3"	4"	5"	6"	7"	8"	9"	10"
Pipe Area (sq. in.)	7.1	12.6	19.6	28.3	38.5	50.3	63.6	78.5
Pipe Circumference (in.)	9.4	12.6	15.7	18.8	22.0	25.1	28.3	31.4

Y-1.4 COMBUSTION AIR FROM INDOORS

- CVA "Required Volume" for Open Combustion Appliances
 - When Open Combustion appliances are located in an indoor room or large space, combustion air is usually obtained from that room/space, rather than from outdoors. The CVA "Required Volume" is determined by the total of Btu/hr Input ratings of the appliances in that room/space.
 - Appliances Included in the CVA Calculation
 - In homes built before 2008, CVA calculations are required only for Open Combustions space heaters and water heaters.
 - In homes built in 2008 or later, CVA calculations include gas cooking appliances (see **WIS Item 8** and **Appendix A**).
- CVA "Required Volume" Calculations
 - The "Standard Method" (2007 CMC §701.2.1) for calculating CVA "Required Volume" for indoor combustion air specifies at least **50 cu. ft.** or room volume for each **1,000 Btu/hr** of total Input of Open Combustion appliances in the space.
 - CVA Volume Alternatives
 - CMC 701.2.2 provides an alternative called the "Known Air Infiltration Rate Method".
 - When the home has enough natural ventilation, this option allows the CVA Required Volume to be *less than* 50 cu. ft. per 1,000 Btu/hr, as explained in **WIS Appendix A, Section 6.0**.
- Vents to an Interior Adjacent Space (see **WIS Item 8**)
 - If room/space is too small to provide the CVA "Required Volume", and outside air vents are not appropriate, vents in the wall and/or door may be installed to bring air in from an adjacent room.
 - When that is done, the volume of the adjacent room/space is added to the original volume.
 - The original volume plus the added volume must provide the CVA "Required Volume".
 - Vents must be **1 sq. in.** for each **1,000 Btu/hr** Input—but a **minimum of 100 sq. in.**—and positioned within 12" of the ceiling and 12" of the floor.

c. CVA Options for Obtaining “Required Volume”

- An example of a confined area needing ventilation to an adjacent room/space is a small, closeable hallway containing a Wall Furnace.
- If the hallway is too small to provide the CVA “Required Volume”, it may be possible to install Upper and Lower louvered vents into an adjacent room or space.
- As an alternative to installing vents, it may be preferable to do one of the following:
 - Replace a solid door with a louvered door (e.g., between the hallway and the living room), or
 - Permanently remove the solid door (with owner’s permission).

4. CVA vents must be checked for, and cleared of, obstructions (insulation, lint, animal hair, etc.)—very important for FVIR Water Heaters (see **WIS Item 8, CVA** ► “Water Heaters with Sealed Combustion Access”).

Y-2 DRAFT TESTS

Y-2.1 MINIMUM DRAFT

1. Draft tests are performed for Open Combustion appliances, as described in **WIS Section 3**:
 - a. **Item 23** for Furnaces and *Storage* Water Heaters,
 - b. **Item 27** for *Tankless* Water Heaters, and
 - c. **Items 30 & 31** for Gas Logs and Gas Fireplaces.
2. Draft Test and Spillage Check—for Natural Draft Appliances
 - a. An Instrumented Draft Test is performed *when possible*, using: (a) a Draft Gauge, (b) the Draft function on a CO Tester, or (c) a Digital Manometer (gauge from Duct Blaster or Blower Door).
 - b. A Visual Draft Test *must* be performed when an Instrumented Draft Test is not possible.
 - c. A Spillage Check *must* be performed on all Natural Draft appliances, *in addition to* the Draft Test.
3. Adequate Draft is always indicated by a *negative* pressure.
 - a. A Draft Gauge is usually calibrated in “inches of water column” (iwc). A Digital Manometer is usually read in Pascals (Pa). A CO Tester with Draft function may read in either iwc or Pa.
 - b. The amount of negative pressure considered “adequate” is affected by the outdoor temperature. The *minimums* are shown in the table below (see **WIS Item 23**).

MINIMUM ACCEPTABLE DRAFT		
OUTDOOR TEMP	IWC MINIMUM	PA MINIMUM
Below 30°F	–0.008 IWC	–2.00 Pa
31°F to 40°F	–0.007 IWC	–1.75 Pa
41°F to 50°F	–0.006 IWC	–1.50 Pa
51°F to 60°F	–0.005 IWC	–1.25 Pa
61°F to 70°F	–0.004 IWC	–1.00 Pa
71°F to 80°F	–0.003 IWC	–0.75 Pa
Above 80°F	–0.002 IWC	–0.50 Pa

Y-2.2 DRAFT TESTS AND SPILLAGE CHECK—NATURAL DRAFT APPLIANCES

1. “Instrumented” Draft Test (see **X-8** and **WIS Section 3, Item 23**):
 - a. Perform with a test instrument on all *Natural* Draft units, when possible. Also may be performed on *Induced* Draft units, *when* drilling a test hole is feasible *and* needed for CO Tests (**X-8.2.b.**).
 - b. Through the test hole drilled in the pipe, insert the Probe of the tester (i.e., Draft Gauge, CO Tester, Digital Manometer) to the center of flue/vent pipe.
 - c. To “Pass,” the pressure must be *negative*, and the reading must be at least as negative (low) as the applicable pressure shown in the table above.

d. A reading that is not negative/low enough is a condition with *Immediate Service Required (Z-1)*.

2. “Visual” Draft Test (Using Smoke):

- a. This is performed on Natural Draft units, when an Instrumented Draft Test is not feasible.
- b. Use a smoke “puffer”, smoke pencil or “generator”, incense stick, or extinguished match (no flames and no cigarettes).
 - When using a match (preferably long wooden type), light it 2 feet away from the appliance, extinguish the flame, and then place it near the Draft Hood opening.
 - Open flames at the Draft Hood can cause unburned fuel in the flue to explode (has happened).
- c. Place smoke along the *entire* leading (top) edge of the Draft Hood opening.
 - If the smoke is consistently drawn inward, it is a “Pass”.
 - If not, or if smoke flows away from the Draft Hood, it is a condition with *Immediate Service Required* (see **Z-1**).

3. Spillage Check:

- a. Perform on all Natural Draft units:
 - Move the back of the hand, a small mirror, or a smoke source along the entire Draft Hood opening.
 - Spillage is present when:
 - Warm moisture is felt on the hand, or
 - There is fogging on the mirror, or
 - Smoke is pushed away from the opening.
- b. Spillage that is continuous (not caused momentarily by gusts of wind) is a condition with *Immediate Service Required* (see **Z-1**).

Y-3 CO TESTS

1. CO Tests—Flue Gas and/or Ambient—are performed on all gas appliances.

2. Ambient CO Tests

- a. Ambient CO Tests are required for:
 - All Space Heating appliances, and
 - Some Water Heaters—when Flue Gas CO Test is not feasible.
- b. Ambient CO Tests
 - CO is measured in the air, rather than inside the flue.
 - Tests are performed as described in **WIS Appendix B** and **WIS Sec. 3, Items 20 and 21**.

3. Flue Gas CO Tests

- a. Flue Gas CO Tests, which measure CO inside the flue (free of dilution/outside air), are required for all gas appliances with accessible flues.
- b. When Flue Gas CO Tests are not feasible, an Appliance Ambient CO Test is performed, per **WIS Appendix B** and **WIS Sec. 3, Items 20 and 21**.

4. CO Action Levels

- a. **Ambient CO Maximums** (see **WIS Items 20 and 21**)
 - Living Space Ambient CO maximum is 9 ppm.
 - Appliance Ambient CO maximums are:
 - For **Space Heating** systems, maximum Appliance Ambient CO is more than 2 ppm above the Second Living Space Ambient CO ppm.
 - For **Water Heaters**, maximum Appliance Ambient CO is 9 ppm.
- b. **Flue Gas CO Maximums** (see **WIS Items 24 to 31**)

- *Pre-Wx Test* Flue Gas CO maximum is **100 ppm (225 ppm for Ovens and Broilers)**. If CO exceeds maximum before weatherization, the appliance must be serviced and declared safe by a qualified technician before infiltration-reduction measures are installed.
- *Post-Service* Flue Gas CO limits are **225 ppm** for Ovens and Broilers, and **100 ppm** for all other appliances.
- If *Post-Wx Test* CO exceeds these limits, immediate corrections are required, and occupants must be advised and protected from exposure to CO. **See Z-1.2.**

5. Clearing the CO Sensor

- Before turning off a CO Tester, run it in fresh air until after the CO reading stops dropping, which allows the pump to push fresh air through the sensor and clear out residual CO.
- This is especially important after measuring high levels of CO (helps maintain sensor accuracy).

“Z”—ACTION INSTRUCTIONS

Z-1 CONDITIONS REQUIRING IMMEDIATE SERVICE (HAZARDOUS CONDITIONS)

1. Examples (see WIS Section 3, Items 17 and 25–31)

Following are examples of *Conditions Requiring Immediate Service*, which must be corrected *before* infiltration-reduction measures are installed. (Though sometimes referred to as “hazardous conditions”, the term “hazardous” should *not* be used when speaking with occupants. Tell them the appliance “does not meet program safety standards, and prompt service is being requested”.)

- Gas Leaks.
- CO ppm above the “Action Level” (also called “High CO”; see **Y-3.4.**).
- Continuous Roll-out
- Continuous Spillage—and/or—flue/vent system obstructions causing Spillage.
- Flame Interference and/or physical evidence of a Cracked Heat Exchanger (cracks, holes, warping, metal fatigue, etc.).
- Unsafe appliance modification (e.g., propane gas used in appliance with natural gas orifice).
- Damaged/disconnected flue/vent pipe—and/or—other condition allowing flue gas to escape.

2. What to Do

- Follow guidelines in Field Policy Preface for WIS Section 3.**
- Do not install infiltration-reduction measures until all such conditions have been corrected. See Sec. 3 Preface, Items 48–52 regarding problems found during Interim Tests and Post-Wx Tests.
- Turn off appliance with such a condition—at the Wall Thermostat, Gas Control Valve, and the Appliance Line (Shutoff) Valve. If applicable, also unplug unit or turn off power at the breaker/fuse.
- Instruct occupants to not use that appliance until service has been performed and the condition has been corrected.
- Record the condition in CASIF Section (A).
- Document client notification, using the applicable CSD form and a notation in CASIF Section D.
- Mark the “*Service Required*” box on CASIF page 1 when any condition with *Immediate Service Required* has not been corrected before the CASIF is returned to the office.

3. Service and Repairs

- Qualified Technician:** Conditions with *Immediate Service Required* must be corrected by a qualified person, which in most cases is:
 - A utility Gas Service Representative, when the appliance fuel is natural gas;
 - An HVAC contractor/technician;
 - A propane dealer’s technician, when the appliance fuel is propane.

- b. **Weatherization crews** do not make adjustments to the gas pressure, air-gas mixture, and other technical adjustments (unless fully trained and authorized to do so). Crews may make only those repairs for which they are trained and qualified, which usually include:
- Correction of Draft Hood abnormalities (e.g., improperly positioned, double, missing).
 - Vent Pipe repairs (e.g., replacement, minor adjustments, securing joints with screws).
 - Replacement of missing components.

Z-2 REQUIRED REPAIRS

Required Repairs are conditions that must be corrected but *do not require Immediate Service*.

1. Examples of *Required Repairs* (See Z-8 for “*Recommended Repairs*”)

- a. No Draft Hood or Multiple Draft Hoods (if there is Spillage or High CO, see **Z-1**).
- b. Gas Flex with soldered-on fittings (avoid bending/disturbing, and see **WIS Item 7** and **Z-10**).
- c. CVA inadequate/incorrect/obstructed (see **WIS Item 8** for Conventional, and **Item 36** for Mobile Homes).
- d. Vent Pipe needing screws in joints or a Vent Cap.
- e. Delayed Ignition with CO ppm *below* Action Level (see **Z-5.1.c.**).
- f. Pilot defects, such as flame size or position improper, IID (intermittent ignition device) does not properly light pilot, or thermocouple/pilot generator does not function properly.
- g. Improper appliance modification, or missing or defective parts, such as the following:
 - Furnace combustion chamber door defective or missing.
 - Wall Furnace front cover/grille is missing or damaged enough to make Furnace unsafe.
 - Furnace Roll-out Shield missing (if unit was manufactured with one).
 - Air Handler door defective or missing (opening must be temporarily sealed for testing).
 - Open Combustion Water Heater with both combustion chamber inner shield and outer door missing.
 - Closed Combustion (Direct Vent or FVIR model) with combustion chamber access not securely closed and sealed.
- h. Return leaks inside the FAU enclosure, or anywhere combustion products can be drawn in.
- i. A primary gas appliance (e.g. Furnace/Heater, Water Heater, Range) that will not operate (*Immediate Service Required* when a Gas Leak is present).
- j. Gas Range with three or more defective burners.
 - A Cooktop with up to 2 non-operational burners, and a non-operational Oven, are *not* Required Repairs. See **Z-5.2**.
- k. Mobile Home that has:
 - Gas cooking, but proper gravity or mechanical ventilation not present (see **WIS Item 35**).
 - Space Heater or Water Heater drawing combustion air from the living space, *unless* requirements of **WIS Item 36** are met.
 - Defective/nonconforming “Isolation of Return Air” (see **WIS Item 37**).
 - Nonconforming Wood Burning Stove, *unless* requirements of **WIS Item 38** are met.
 - Water Heater compartment floor that is deteriorated and unsafe (see **WIS Item 39**).

Note: When corrections are not feasible for any of these nonconforming conditions, infiltration-reduction measures must not be installed.
- l. Gas Clothes Dryer in the living space with Moisture Exhaust not exhausted outdoors (see **WIS Item 17** for Conventional Homes and **Item 34** for Mobile Homes).
- m. Exceptions—Abandoned Appliances: A Clothes Dryer or secondary appliance (e.g. a second or supplementary Space Heater, Range or Water Heater) that is defective or will not operate, does not need to be tested or repaired if it is properly abandoned (see **Z-7**)
 - Prior to abandoning an appliance, owner’s permission must be obtained and documented in writing, including a notation in CASIF Section D.
 - The appliance must be properly abandoned before infiltration-reduction measures are installed.

2. What to do: (Also see guidelines in Field Policy Preface for **WIS Section 3**.)

- a. Record *Required Repairs* in CASIF Section (B).
- b. Inform client, and document client notification in writing, including a notation in CASIF Section (D).
- c. Arrange for or make repairs in conjunction with weatherization.

3. Service and Repairs:

- a. *Required Repairs* must be performed by a qualified person, which, in most cases, is a utility Gas Service Representative, an HVAC contractor/technician.
- b. **Weatherization crews** may make repairs for which they are trained and qualified, which may include the following:
 - Secure a loose Water Heater Draft Hood with screws.
 - Replace defective vent system components and install replacement Vent Cap.
 - Secure single-wall metal flue/vent pipe joints and connections with screws.
 - Correct other minor flue/vent problems.
 - Replace minor hardware, such as Water Heater burner access doors.
 - Install additional, or correct nonconforming, CVA venting.
 - Install a Clothes Dryer moisture exhaust.

Z-3 GAS LEAKS AND SOLDERED/UNSAFE GAS CONNECTORS

Checks for Gas Leaks include the following, and must be conducted in accordance with **WIS Item 7**.

- Note that the Gas Control Valve can *start* leaking *after* the appliance begins operating, so it should be rechecked after the burner lights.
- Valves and fittings are most important, but pipes can have pin-hole leaks and should be checked.

1. Electronic Leak Detector

- a. Recommended method (easier for hard-to-reach locations, and doesn't rely on sense of smell).
 - **Caution:** Do not use an Electronic Leak Detector *after* applying a commercial Leak Detection liquid, because vapors from the liquid may produce a false positive result. Always use the Electronic Leak Detector first, and then use bubbles to locate any leak detected electronically.
- b. Best method in the following situations:
 - Appliance is difficult to move and/or may damage the floor, and/or
 - The flex connector is pre-1973 or is old-style with soldered fittings—**see Z-10**.
 - In those cases, check any valves/fittings that can be reached without moving the unit.

2. Bubble Test

- a. Application of a commercial Leak Detection liquid or spray (or solution made with liquid detergent/soap and water), used to pinpoint the location of a leak found electronically or by smell.
 - Apply to fittings on valves, flexible gas connectors, and pipes (including caps on pipes and valves)—**but avoid spraying into the internal parts of the appliance Gas Control Valve.**
- b. Not feasible when valves and fittings cannot be safely accessed, such as when:
 - Range or Oven is built in.
 - Appliance is heavy, and moving it is difficult and/or may damage the floor. In that case, dab or spray liquid onto any valves/fittings that can be reached without moving the unit.

3. “Olfactory Test” (Not feasible when compromised sense of smell cannot properly detect odorant.)

- a. Sniff with your nose for the odor of leaking gas in the following locations:
 - Within 2 feet above natural gas valves and fittings.
 - Within 3 inches below propane valves and fittings.
- b. Follow up with Bubble Test to pinpoint location of any leak detected by smell.

4. A Gas Leak is a Condition with *Immediate Service Required* (see Z-1).

If a Gas Leak is found, the following must be done immediately:

- a. Warn client to not use appliances that could ignite leaking gas.
- b. Postpone remaining CAS tests that could ignite leaking gas until after the leak is repaired.
- c. Ask the client to call the utility company Gas Service Dept. (or LP gas dealer) to fix the leak.
- d. If the odor of leaking gas is strong inside the house:
 - Avoid using light switches, telephone, or flashlight (3-cell or larger), to prevent electric sparks that might ignite gas fumes.
 - Telephone from outside the house (e.g., on a cell phone or a neighbor's phone).
 - *Wait outside for repair service, and do not turn off the gas at the meter (unless instructed to do so by the utility)—because:*
 - Gas is most explosive in a mixture of 10% gas and 90% air.
 - Turning off the valve at the gas meter when the concentration is over 10% can allow dilution by air to return the mixture to a more dangerous state.
- e. Record gas leaks and repairs in CASIF Section (A).
- f. **Gas leaks must be repaired only by qualified persons.**
 - That usually is a utility gas service technician, a propane dealer technician, a qualified and licensed appliance repair contractor, an HVAC contractor/technician, or a plumbing contractor (for Water Heaters).
 - The Wx crew should not attempt to repair gas leaks, because a botched attempt to stop the leak could result in a fitting, pipe, or valve breaking—creating a worse condition and possibly the need for an extensive repair.

5. Soldered Flexible Gas Connectors (see Z-10)

- a. Background:
 - Until about 1986, uncoated brass Flexible Gas Connectors were made with one or both threaded fittings soldered onto the flex tubing (“butt-soldered” joints).
 - The solder may react with gas and become weakened—causing the soldered joint to break loose when the connector is disturbed, creating a catastrophic gas leak (which can occur when moving a Gas Range or Clothes Dryer).
- b. Identification—do the following when checking for gas leaks in older homes:
 - Look for uncoated brass Flexible Gas Connectors with either or both fittings soldered onto the flex tubing.
 - *Use information and procedures in Z-10 to help with the identification and correction of soldered Flexible Gas Connectors.*
 - You may also visit the Consumer Product Safety Commission website at <http://www.cpsc.gov> and search for “soldered flexible gas connectors”.
- c. **When a Soldered Flexible Gas Connector is identified:**
 - *Do not bend or otherwise disturb the connector or fittings—and do not move the appliance.*
 - *If connector is leaking gas, turn off the Appliance Line Valve. Do not attempt to tighten fittings. List as a condition with Immediate Service Required in CASIF Section (A).*
 - If not leaking gas, list the connector as a Required Repair in CASIF Section (B).
 - Replace with a new listed Flexible Gas Connector, if qualified and authorized to do so, or
 - Contact the gas supplier to determine if they have a replacement program (some utilities replace soldered connectors at no charge).

6. Copper Tubing Used as a Gas Connector

- a. Background
 - In some older installations, copper tubing was used to bring gas from the Appliance Line Valve to the appliance. Copper reacts with gas, causing deterioration of the metal and sometimes

- blockage of the line; so copper is no longer used.
- However, copper connector replacement is *not* a Required Repair, *unless* clogged or leaking.
- b. When a gas connector is identified as copper tubing:
 - If it is not clogged or leaking:
 - List it as a Recommended Repair in CASIF Section (D).
 - Inform the home owner/manager, and suggest contacting the gas supplier to determine if they offer any assistance in replacing copper gas connectors (some utilities do).
 - If it is clogged or leaking:
 - List it as a Required Repair in CASIF Section (B).
 - Replace the connector with a new listed Flexible Gas Connector, if qualified and authorized to do so (or have it done by a qualified technician), or
 - Contact the gas supplier to determine if they have a replacement program.

Z-4 FLUE AND VENT DEFECTS

1. **Conditions with *Immediate Service Required*:** A Flue/Vent System with a disconnected joint, Draft Hood defect, obstruction, or any other condition which adversely affects draft or causes combustion products to enter the home is a condition with *Immediate Service Required* (see Z-1).
2. **Improper Terminations**
 - a. See an overview of program criteria, based on CMC requirements, laid out over several pages in **WIS Section 3, Items 9 to 16** (Conventional) and **Item 33** (Mobile). Note that requirements differ by appliance type, location of the flue/vent pipe, and type of home (Conventional or Mobile).
 - b. Conditions with *Immediate Service Required* must be corrected before installation of infiltration-reduction measures, including Duct Repair & Sealing.
3. **Single- and Double-Wall Pipes and Clearances**
 - a. Single-wall pipe is called a “vent connector”, which is used to connect a Listed appliance to a Double-wall pipe (“B Vent”, referred to in the CMC as the gas “Vent”).
 - Single-wall pipe is allowed only below the ceiling, where it connects to B Vent, usually in a “support box” or “thimble”.
 - Double-wall pipe must extend beyond the ceiling and into the attic, or beyond a sloped ceiling and through the roof.
 - b. Clearances to Combustibles
 - Single-wall pipe should have 6" clearance to combustibles (wood framing, sheetrock, etc.).
 - Double-wall pipe clearance is as specified by the manufacturer, which is usually at least 1".
 - When clearance is less, it is a Recommended Repair, listed in CASIF (D) & explained to client.
 - If there is severe charring and a fire hazard, it is a Required Repair, listed in CASIF (B).
4. **Masonry Fireplace with Gas Appliance:**
 - a. Check for Gas Leaks when a Gas Lighter, a Gas Log, or a Gas Heating Unit (“Gas Fireplace”) is present.
 - b. Also perform CO and Draft Test per CASIF (H) when a Gas Log or a Gas Heating Unit is used as the *primary* heater.
 - c. When a Gas Log is installed, the CMC requires the fireplace damper to be permanently blocked open to a sufficient amount to prevent spillage of combustion products into the room.
 - This is commonly done by installing “damper clamps” to hold the damper slightly open.
 - The following are *Required Repairs* when a Gas Log is the *primary* heating source:
 - A Damper that is not blocked open (e.g., with a permanently-installed damper clamp).
 - A Gas Log with a damper clamp in place that does not pass the Visual Draft Test and/or CO Test.

5. Unvented Appliances

- a. If a portable unvented heater (kerosene or gas) or a cooking appliance (Cooktop or Oven) is used to heat the living space, do not install infiltration-reduction measures (including Duct Repair & Sealing) until corrective action is taken (see the WIS Section 3 Field Policy Preface).
 - If a portable unvented heater is present, it must first be removed from the home.
 - If the *primary* Furnace/Heater is defective and cannot be used, it must be repaired or replaced (record in CASIF Section (A) or (B), as applicable).
- b. Occupant Education (see the WIS Section 3 Field Policy Preface):
 - Occupants must be informed that heating with an unvented source brings CO and other combustion byproducts into the home, which can be unsafe, especially while people are sleeping.
 - Document education in writing, including a notation in CASIF Section (D).

Z-5 BURNER ABNORMALITIES

Conditions listed below are examples of burner abnormalities. Some are *Required Repairs* that must be corrected before infiltration-reduction measures are installed. Some are simply *Recommended Repairs*.

1. Space Heating and Water Heating Units:

- a. **High CO:** Flue-gas or Ambient CO ppm exceeds Action Levels specified in **Y-3.4** (see **Z-1**).
- b. **[FAU only] Flame Interference:** A change in flame pattern and/or color as the blower comes on usually indicates a defective heat exchanger. Also look for burner-off visual evidence of a defective heat exchanger (crack or metal fatigue, visible with a mirror and strong light) (see **Z-1**).
- c. **Ignition and Flame Irregularities:**
 - Include **Delayed Ignition** (with a bang or whoosh) and/or **Roll-out, Large Yellow Flames** (over 50% yellow), **Soft Lazy Flames**, **Smothering Flame** (flame recirculation) etc. (see **Z-2**).
 - Note that *some* burners (e.g., in Space Heaters, Decorative Fireplaces, and Gas Logs) are designed to burn with a **yellow flame**. Service is *not* required if (a) the burner is normal per manufacturer's specifications, and (b) it is *not* producing excessive CO or soot (e.g., carbon in the Combustion Chamber and/or Draft Hood).

2. Cook Stove/Oven:

- a. *Required Repairs* (see **Z-2**) recorded in CASIF (B) include 3 or more Cooktop burners not operating, or the Range Oven door is broken or does not close completely.
 - Range Cook Tops and Ovens may be Repaired, if feasible; if not feasible, they are Replaced.
 - Built-in Ovens are not Repaired/Replaced at all, but rather are Abandoned.
- b. If a Gas Leak or other condition with *Immediate Service Required* is not present, the following problems are "*Recommended Repairs*" to be recorded in CASIF (D). They are not reasons for Repair or Replacement, and they do not prevent installation of infiltration-reduction measures:
 - Pilot does not work, but the burner(s) can be lit with a match or lighter.
 - A burner knob/valve is frozen, or for some other, a burner will not light at all (even with a match).
 - One or two Cooktop burners, or the Oven and/or Broiler burner, is non-operational.

3. Aldehydes: Aldehydes have an acrid odor and irritate the nose and throat. Aldehyde odor is a sign of improper burner operation and creation of CO—and a warning to look for defects and high CO.

Z-6 DEFAULT BTU/HOUR INPUT RATINGS

When the Btu/hr Input rating cannot be obtained from the manufacturer's nameplate, the following "default" values may be used.

1. CVA and MVR calculations

a. **Forced Air Furnaces:**

- 25,000 Btu/hr per burner

b. **Wall Furnaces:**

- Single Sided: 35,000 Btu/hr
- Double Sided with two burners: 60,000 Btu/hr

c. **Floor Furnaces:**

- Standard: 30,000 Btu/hr (usually 22" wide)
- Large: 60,000 Btu/hr (usually wider than a single floor-joist bay)

d. **Free-Standing Heaters:**

- Small (up to 25" wide): 25,000 Btu/hr
- Standard (26" to 32" wide): 50,000 Btu/hr
- Large (34" or wider): 60,000 Btu/hr

e. **Water Heater:**

- 1,000 Btu/hr per gallon
- Note: When the unit is in an attic, adequate attic ventilation is required.

2. MVR calculations: The following appliances do not require CVA calculations; however, the default values are included for MVR calculations:

- a. Cooktop: 10,000 Btu/hr per burner,
- b. Ovens: 20,000 Btu/hr per burner,
- c. Clothes Dryers: 25,000 Btu/hr

Z-7 ABANDONED APPLIANCES

For detailed policies regarding abandoning appliances, see the WIS Section 3 Field Policy Preface and WIS Definitions.

1. An abandoned appliance: **a.** does not require CAS testing, and **b.** does not prevent installation of infiltration-reduction measures.
2. An appliance is considered abandoned only if:
 - a. the Flex Gas Connector is removed, and
 - b. the Appliance Line (Shutoff) Valve is capped or the Valve is removed and the gas line is capped.
3. When a Cooktop or Oven burner is abandoned, the Burner Valve must be capped when possible.
4. Procedures (see WIS Section 3 Field Policy Preface)
 - a. The homeowner (landlord or agent, if a rental) must give written permission before an appliance is abandoned. Document permission (e.g., in the "Safety Issues" section of the Customer Summary Assessment Form), and make a notation in CASIF Section (D).
 - b. An appliance or burner may be abandoned only by a qualified person—which may include Wx crew persons who are trained and authorized to perform abandonment.
 - c. An appliance not being used by occupants (turned off and partially/totally disconnected) must be "properly" abandoned (Step 2 above, with permission per Step 4.a.), before Duct/Shell Sealing.

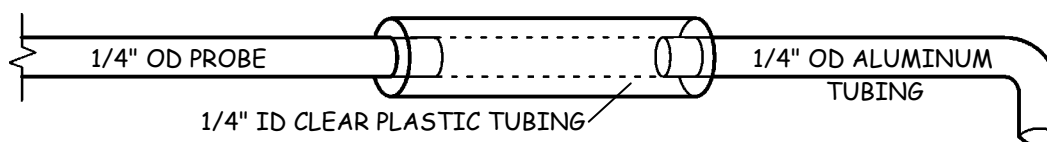
Z-8 RECOMMENDED REPAIRS

"Recommended Repairs" are nonconforming conditions that do not create an immediate health and safety hazard (e.g., no gas leak, and CO does not enter the living space). Examples include:

(a) flue/vent pipe with inadequate clearance to combustibles, (b) Cookstove defects listed in **Z-5, 2.b.**, and (c) nonconforming appliances that do *not* affect the living space (see **WIS Item 2**). Repair is not required, and *Recommended Repairs* do not prevent Shell and Duct sealing.

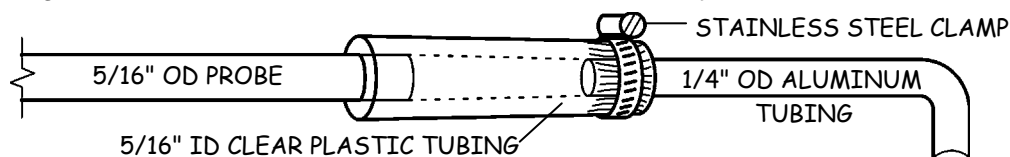
Z-9 CO TESTER PROBE EXTENSIONS

1. A CO Tester "Probe Extension" is required when a straight, rigid Tester Probe cannot reach into the exhaust stream to *properly* measure *CO free of dilution air*. For example, a straight Probe usually cannot reach *inside* the following:
 - a. Water Heater center tube, to access both sides of the baffle.
 - b. Wall Furnace exhaust port, to access both sides of the baffle.
 - c. Closed Combustion/Direct Vent (DV) flue (e.g., flue termination of a Mobile Home FAU, Direct Vent Wall Furnace, and Closed Combustion or Induced Draft Water Heater).
2. Probe Extensions are made with aluminum tubing and clear plastic tubing. (Copper tubing is not used, because it may react chemically when exposed to hot flue gases.)
 - a. The "standard" Probe Extension is about 1 foot long. For Mobile Homes, a 4' to 8' long extension may be needed to reach FAU flue terminations (usually located several feet from the roof edge).
 - b. At one end of the aluminum extension, 1" to 2" of tubing is bent approx. 90° to form an "L" shape.
 - c. The Probe Extension is connected to the Tester Probe with clear plastic tubing, approx. 1 foot long.
 - d. Required materials are found in hardware and auto parts stores (e.g., clear plastic tubing, aluminum tubing, and worm-drive clamps), and at gas appliance parts houses (e.g., 1/4" pilot tubing).
3. **1/4" OD Probe Extensions for 1/4" OD Probes (e.g., on Monoxors)**
 - a. Aluminum Tubing, 1/4" OD (Outside Diameter)
 - OD of the aluminum Probe Extension should match the OD of the CO Tester rigid metal probe, and the clear plastic tubing should fit onto both of them without clamps. The Probe Extension is made with 1/4" OD tubing, so it will fit into a standard 5/16" sampling hole.
 - b. Clear Plastic Tubing, 1/4" ID (Inside Diameter)
 - When selecting the plastic tubing, have available both the aluminum tubing and CO Tester Probe. 1/4" ID plastic tubing should fit, but check because brands vary. Determine the proper size by sliding the plastic tubing over both the Tester Probe and aluminum Probe Extension. Get plastic tubing that fits snugly but can easily be twisted on and off the CO Tester Probe.
 - c. Some older CO Testers (e.g., early Monoxor II) have a *removable* metal Probe.
 - The 1/4" OD aluminum "extension" can fit directly into the handle (plastic tubing not needed).
 - Be careful to not lose or damage the small plastic ferrule inside, when installing and removing the aluminum Probe Extension directly into the CO Tester probe handle.



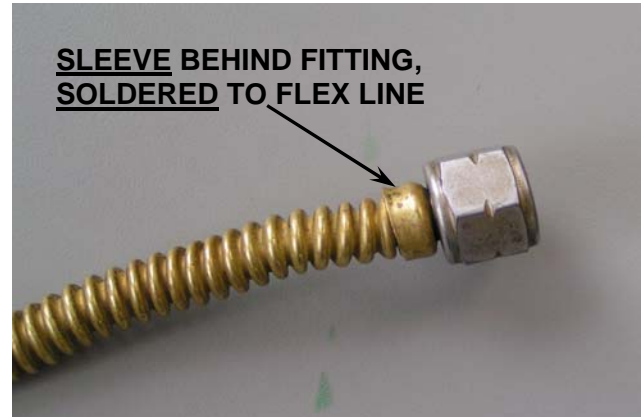
4. 5/16" OD Probe Extensions for 5/16" OD Probes (e.g., on Fyrite Pro)

- a. Some CO Testers have a 5/16" OD metal Probe, so larger ID clear plastic tubing is required. When selecting tubing, slip it over the Probe to find a diameter that is removable but not loose.
- b. Keep Probe Extension aluminum tubing at 1/4" OD, so it will fit into a standard 5/16" sampling hole (eliminating the need for larger holes and larger plug buttons).
- c. Because the plastic tubing ID is larger than the OD of the aluminum Probe Extension, use a small stainless steel worm-drive clamp to secure the plastic tubing to the Probe Extension. (Do not clamp plastic tubing to the CO Tester Probe, because it must be easily removable from the Probe.)



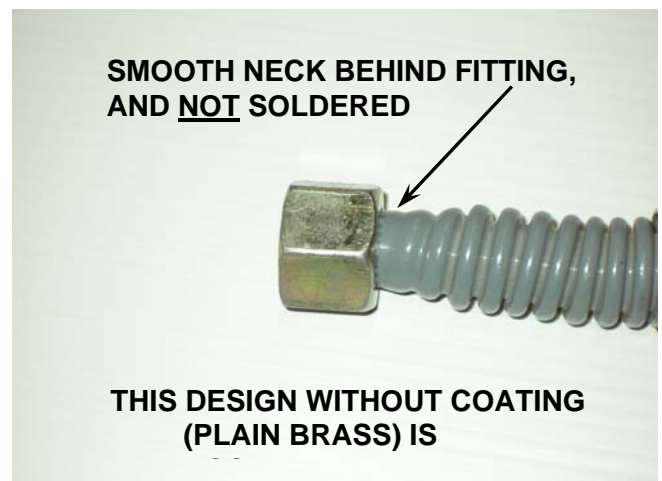
Z-10 SOLDERED & OTHER UNSAFE FLEXIBLE GAS CONNECTORS

1. A flexible gas connector is considered unsafe and *must be replaced* with a new listed flexible gas connector when it is: **kinked, corroded, shows signs of visible wear, was manufactured before 1973** (per date ring near fitting), **or has any soldered connections.**
2. During the CAS visual inspection and check for gas leaks, the flexible gas connector must be visually examined for these unsafe conditions. If a soldered flex connectors is found in a home with natural gas, the utility Gas Service department should be contacted for possible replacement at no charge to the customer.
3. It is important to correctly identify and respond to soldered gas connectors, so keep in mind the following:
 - a. **All soldered** flexible gas connectors are made of **uncoated brass**, and they **must** be replaced.
 - b. **Not all uncoated brass connectors are soldered**, and if *not* soldered, replacement is not needed.
4. To avoid calling for service for a brass flex connector that's **not** soldered, learn to recognize ones that are.
 - a. Top left picture is a **soldered** connector with corrugations right up to the fitting (soldered joint location).
 - b. Top right picture is a **soldered** flex with a short sleeve covering the corrugations behind the fitting.
 - c. The bottom picture is an **acceptable** connector with a smooth neck entering the fitting. Note that it has a **gray coating**, which soldered flex connectors do not have.



IMPROPER BRASS FLEX CONNECTORS WITH SOLDERED-ON FITTING AND NO COATING

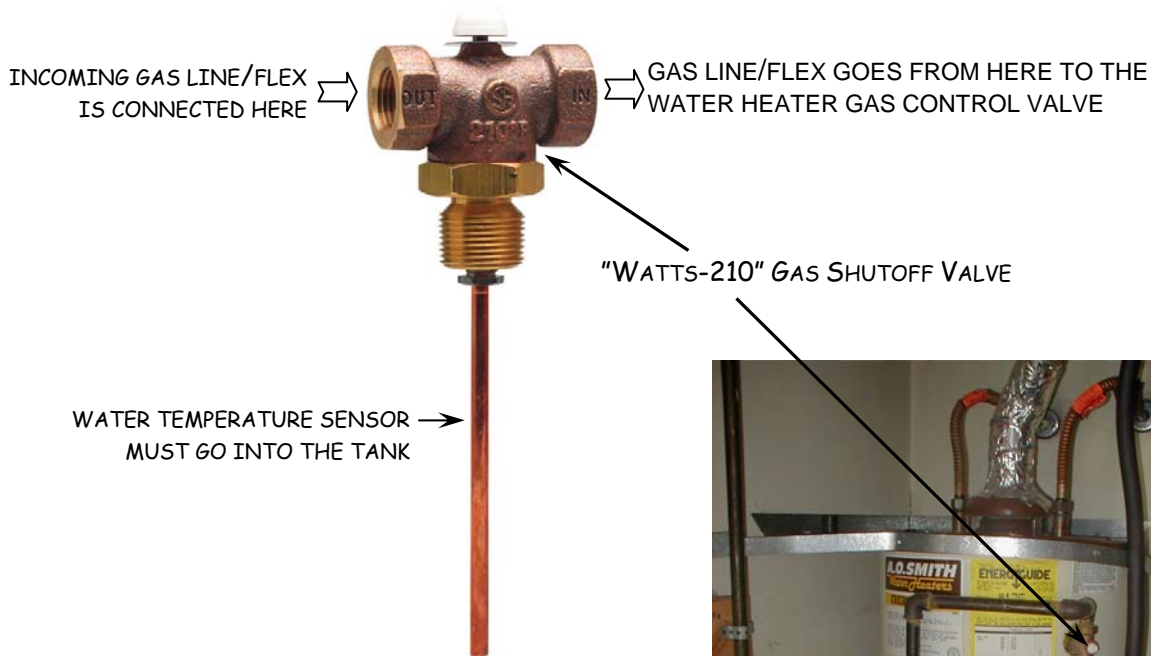
5. **Proper** flex connectors: (a) may be *brass without a gray coating*, **or** (b) may be *silver* (stainless steel instead of brass), **and** (c) have a *smooth neck* between the corrugations and the fitting.
6. **Improper** (soldered) flex connectors: (a) are *always brass color*, **and** (b) have *corrugations right up to the fitting*, **or** (c) have a *short sleeve* covering the corrugations behind the fitting.
7. Flexible gas connectors *dated before 1973* and uncoated brass connectors with *soldered-on fittings* are unsafe. *Moving the appliance, even slightly, to inspect the gas connector or check for gas leaks, can cause complete failure of an older, weakened soldered joint.*
 - a. **If joints appear to be soldered, do not move the appliance to check the gas valve or flex connector!**
 - b. If in doubt about whether a flex connector is soldered, call your supervisor for advice and assistance.



PROPER FLEX CONNECTOR WITH SMOOTH NECK AND GRAY COATING (IT COULD ALSO BE UNCOATED PLAIN BRASS)

Z-11 AUTOMATIC GAS SHUTOFF VALVE

1. When a Temperature & Pressure (T&P) Relief Valve is not present, in *some* cases it is *possible* that:
(a) the Water Heater is safe (does *not* Fail CAS), and (b) Water Heater and Pipe Insulation *are* feasible.
2. This is true when the tank has a properly-installed **Automatic Gas Shutoff Valve** (such as a "Watts-210"). A "210" valve is identifiable by the gas lines (not water pipes) attached to it, as shown in the picture below.
3. When installation of a gravity-flow T&P drain line to outdoors is not practical, an Automatic Gas Shutoff Valve may be installed Instead of the more-common T&P Relief Valve. An Automatic Gas Shutoff Valve does not have a drain line, so it is sometimes used in apartment buildings and in basements.
4. The "210" valve shuts off fuel to the Gas Control Valve when water temperature in the tank reaches 210°F. To function properly, the Automatic Gas Shutoff Valve must be located within 6 inches of the tank, the same as a T&P Relief Valve.
5. When the Automatic Gas Shutoff Valve is installed on the *side* of the tank, there may be little or no clearance between the tank and the gas line to/from the valve (as pictured below).
 - Insulation must not cover the Automatic Gas Shutoff Valve nor the gas line connected to it.
 - If there is too little clearance (less than 1 inch) to fit the blanket behind the gas line, Water Heater Insulation is not feasible.



GAS LINE TIGHT AGAINST TANK



Z-12 “NOx ROD” FURNACE RECALL INFORMATION

1. When performing CAS visual inspection of a horizontal furnace, it is important to determine whether it is one of the “NOx rod furnaces” subject to recall. These furnaces have potential fire hazards associated with the burner design. “NOx rod furnaces”, which were sold in California between 1983 and 1995, are listed in the table below.
2. “NOx rod furnaces” are gas-fired horizontal furnaces equipped with **steel “NOx rods” installed above the burners**. Any such furnace identified during CAS Testing must be checked by a qualified technician.



These gas-fired horizontal furnaces have steel “NOx rods” (right) installed above the burners. For additional pictures, go to: <http://www.furnaceinspect.com/modelhelp.shtml>

3. CAS Procedure

- a. Check the nameplate on each horizontal furnace to determine if it was manufactured before 1995. If it was (or you can't tell), check to see if the model number is one listed in the table below. Obtain additional information at the websites listed in Item 5 below.
- b. Schedule the furnace for examination by a qualified technician when:
 - The furnace is on the recall list, or
 - The model number cannot be determined (e.g., missing or illegible nameplate), or
 - Visual inspection reveals NOx rods in the combustion chamber.
- c. If the furnace is determined to be a “NOx Rod Furnace” subject to recall, then:
 - The furnace Fails CAS and must be replaced.
 - If replacement is not feasible, infiltration-reduction measures must not be installed.

4. List of Recalled Models

COMPANY NAME	TRADE NAME	“NOx Rod Furnace” MODEL NUMBERS
Addison Products Co.	Weatherking	GHC
Amana Company	Amana	GSE50DN3X, GSE75DN3X, GSE100DN5X
Arco Comfort Products	ACP, Arcoaire, Northrup	GHB
Bard Manufacturing	Bard	ESG040D36B, ESG040D36BC, ESG050D36B, ESG050D36BC, ESG060D36B, ESG060D36BC, ESG060D48B, ESG060D48BC, ESG080D60B, ESG080D60BC, ESG100D60B, ESG100D60BC,

COMPANY NAME	TRADE NAME	“NOx Rod Furnace” MODEL NUMBERS
		ESG120D60B, ESG120D60BC, ESG140D60B, ESG140D60BC, ESG050D36D, ESG060D48D, ESG075D48D, ESG080D60D, ESG100D60D, ISG060D36AX, ISG080D48AX, ISG100D60AX, ISG120D60AX
Carrier Corporation	Sunburst by Carrier Southern California	HAC040N(D, E, or F)3RXC, HAC050N(D, E, or F)5RXC, HAC050ND3RXD, HAC060N(D, E, or F)4RXC, HAC075N(D, E, or F)4RXC, HAC080N(D, E, or F)5RXC, HAC100N(D, E, or F)5RXC
Climate Control	Climate Control	GHC
Coleman Company (Evcon Industries)	Coleman	2505-25090B/ 2505-2509C, BGH
Consolidated Industries	Consolidated	HAC/HCC, HBA
DMO Industries	Duomatic-Olsen, Olsen, Airco	HCC, HBA
Goettl Air Conditioning, Inc.	American Best, Goettl	HAC040N(D, E, or F)3RCX, HAC050N(D, E, or F)3RCX, HAC040N(D, E, or F)3RXD, HAC050N(D, E, or F)3RXD, HAC040N(D, E, or F)3RXC, HAC050N(D, E, or F)3RXC, HAC060N(D, E, or F)4RXC, HAC075N(D, E, or F)4RXC, HAC080N(D, E, or F)5RXC, HAC100N(D, E, or F)5RXC, HCC040N(D, E, or F)3RX, HCC050N(D, E, or F)3RX, HCC060N(D, E, or F)4RX, HCC075N(D, E, or F)4RX, HCC100N(D, E, or F)5RX, HBA040N(D, E, or F)3RX, HBA060N(D, E, or F)3RX, HBA080N(D, E, or F)4RX, HBA100N(D, E, or F)5RX, HBA120N(D, E, or F)5RX
Goodman Manufacturing Company	Franklin Electric, Goodman, GMC, Hamilton Electric, Janitrol, Johnstone, Liberty	HBA040ND3(X, RX, XC or RXC), HBA060ND3(X, RX, XC or RXC), HBA080ND4(X, RX, XC or RXC), HBA100ND5(X, RX, XC or RXC), HBA120ND5(X, RX, XC or RXC), HCA040ND3(X, RX, XC or RXC), HCA060ND3(X, RX, XC or RXC), HCA080ND4(X, RX, XC or RXC), HCA100ND5(X, RX, XC or RXC), HCA120ND5(X, RX, XC or RXC), HCA140ND5(X, RX, XC or RXC), HCC040ND3(X, RX, XC or RXC), HCC050ND3(X, RX, XC or RXC), HCC060ND4(X, RX, XC or RXC), HCC075ND4(X, RX, XC or RXC), HCC080ND5(X, RX, XC or RXC),

COMPANY NAME	TRADE NAME	“NOx Rod Furnace” MODEL NUMBERS
		HCC100ND5(X, RX, XC or RXC)
Heat Controller, Inc.	Comfort-Aire	GSH40-T3N-X, GSH50-T3N-X, GSH60-T4N-X, GSH75-T4N-X, GSH80-T5N-X, GSH100-T5N-X
ICG/Keeprite	Keeprite	HAC/HCC, HBA
Johnson Supply	Air Star	SGH
Magic Chef Air Conditioning	Magic Chef	EG, ENG
MLX Refrigeration and Air Conditioning	Heatmaster	HAC/HCC, HBA
Premier Furnace Company	Premier, Sunburst, Sun Glow, PFC, Carrier, Sunbelt	HAC/HCC, HBA
Sears	Kenmore	735
Square D Company	Sundial	GH
The Trane Company	Trane (XE60, XE70, XL80), American Standard	THN050A936A, THN060A948A, THN075A948A, THN100A960A; also THS and THD
Westbrook Distributing, Inc.	Heatmaster	HAC/HCC
Any company	Any brand	HAC/HCC

5. Additional information may be obtained online at the following websites:

- FAQ website: <http://www.furnaceinspect.com/questions.shtml#1>
- CPSC recall list: <http://www.cpsc.gov/cpscpub/prerel/prhtml01/01189.html>
- Fire Marshal's recall list: <http://www.furnaceinspect.com/includedmain.shtml>